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Jim Price, TNRCC
Ed Michel, TNRCC
Pete Breitenbach, TNRCC
Chris Kennedy, TNRCC
Cecilia Williams, NMED (New Mexico Environment Department)
Victor Paramo, SEMARNAP-INE
Jose Trevino, Chihuahua
Oscar Ibanez, Ciudad Juarez
Jesus Reynoso, El Paso
Rich Scheffe, EPA-OAQPS
Quang Nguyen, EPA-Dallas
J.T. Lee, Los Alamos National Laboratory
Clay Heskett, Los Alamos National Laboratory
Steve Ziman, Chevron Corporation

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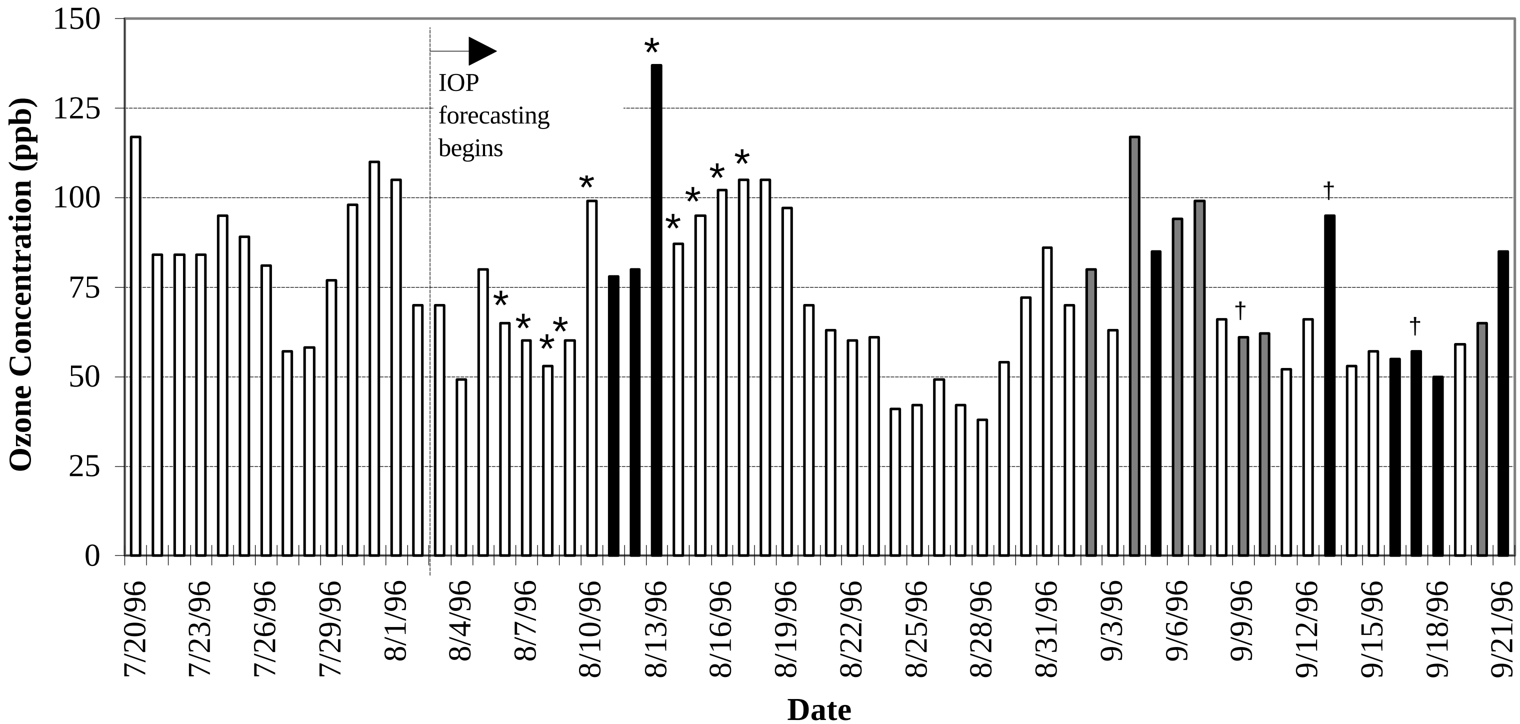

last updated 9/21/96

Bold Bars indicate IOPs, and halftone bars indicate additional days the aircraft operated (supplemental flights).
* - Supplemental surface hydrocarbon samples were collected.
†- Hot-air balloon operated.
Note: On 8/14/96 surface hydrocabon and carbonyl sampling occurred without aircraft sampling. Aircraft sampling on 8/11/96 included a late-night flight only.

Figure 1-2.   Daily maximum hourly ozone concentrations in El Paso. Note that preliminary data were used and changes in the data may occur.

2. MEASUREMENTS AND COORDINATION

2.1 SUMMARY OF MEASUREMENTS

2.1.1 Surface Air Quality Measurements

Table 2-1 lists the positions (latitude, longitude, and elevation) and observables for monitoring sites that received temporary surface air quality and meteorological equipment for the 1996 Paso del Norte Ozone Study. AeroVironment, Inc. (AV) and Los Alamos National Laboratory installed and operated the temporary monitoring equipment. Temporary equipment included Teco 42 NO_x analyzers (upgraded to Teco 42s analyzers) with lower detection limits (ldls) of 0.5 ppb, Dasibi 1003AH O_3 analyzers with ldls of 1 ppb, and hydrocarbon canister and carbonyl Sep-Pak autosamplers. Between August 31 and September 6, the Teco 42s at Turf Road was inoperable. A ML8840 NO_x analyzer (ldl 2 ppb) substituted until the unit was repaired and replaced on September 10.

Table 2-2 gives the positions and observables for the previously existing network of surface air quality sites in El Paso-Ciudad Juarez-Sunland Park. **Figure 2-1** illustrates the locations of the air quality monitoring sites ~~research stations~~ in the El Paso-Ciudad Juarez-Sunland Park area.

2.1.2 Surface Hydrocarbon and Carbonyl Measurements

Surface Hydrocarbon Measurements

Hydrocarbon samples were collected in polished stainless steel canisters at 12 of the surface air quality and meteorological research sites. Routine hydrocarbon samples were collected at three of these sites as part of existing network operations. Canisters were collected on a 6-day schedule at El Paso CAMS 12 (UTEP) and El Paso CAMS 30 (Ascarate Park). A continuous GC analyzer was operated by TNRCC at the Chamizal Park site. Samples were collected by AV and Los Alamos National Laboratory (LANL) at 4 sites concurrent with IOP measurements (Winn Road, Turf Road, 20-30 Club, and El Paso CAMS 6) and at 5 sites as part of a special hydrocarbon survey (El Paso CAMS 30, Sunland Park, Zenco, Franklin Mountain, Dyer Street). For IOP sampling, two-hour samples were collected 5 times per day at 0600-0800, 0800-1000, 1000-1200, 1200-1400, and 1600-1800 MDT. For the hydrocarbon survey, two-hour samples were collected twice per day at various times. Between August 6 and August 17, the special hydrocarbon survey extended to several source-specific locations described as Chevron Tank, Chevron Tank South, Chevron Tank FCC, Police Station, Service Gas Co., Delmex (ITT), Delmex downwind, Propane Bus, Paint Shop, and Juarez Traffic (exact locations will be specified later). The purpose of the hydrocarbon survey was to provide supplementary or source-specific data.

Desert Research Institute (DRI), the USEPA, and the University of Texas at Austin (UTA) will analyze nearly all ~~approximately 50 percent~~ of the samples collected at Winn Road and Turf Road and from the aircraft and hot-air balloon, with the exception of those collected on September 18. The USEPA (Bob Seila) and Instituto del Petroléo Mexicano (IMP) (Jose-Luis Arriaga) will analyze the

Table 2-1. Temporary air quality research stations operated during the 1996 Paso del Norte Ozone Study.

Site	ID	Latitude (decimal degrees)	Longitude (decimal degrees)	Elevation (m msl)	O_3	NO	NO_x	CO	PM	Hydrocarbons	CAR	WS	WD	T	RH	UV
Franklin Mountain	FKM	31.79	-106.48	1428	X	X	X			Aug 6-10[c]		X	X	X		
Turf Road	TRF	31.81	-106.25	1221	X	X	X			IOPs[b]	IOPs[b]	X	X	X	X	X
Dyer Street	DYR	31.92	-106.39	1195	X	X	X			Aug 6-10[c]		X	X	X		
Winn Road, El Paso	WIN	31.66	-106.31	1117	X	X	X			IOPs[b]	IOPs[b]	X	X	X	X	
20/30 Club	M23	31.74	-106.47	1150	X	X[a]	X[a]			IOPs[a,b]	IOPs[a,b]	X	X	X	X	X
El Paso Downtown CAMS 6 (Campbell)	TED	31.7625	106.4869	1140	X	X	X	X		IOPs[a,b]						
Advance Transformer	MJA	31.69	-106.46	1167	X	X[a]	X[a]	X	X			X	X	X		

O_3 - Ozone, NO - Nitric oxide, NO_x - The sum of nitric oxide and nitrogen dioxide, CO - Carbon monoxide, CAR - Carbonyls, WS - Wind speed, WD - Wind direction, T - Temperature, RH - Relative humidity, UV - UV radiation.

[a] Temporary equipment installed at existing sites; all other equipment at these sites is permanent.

[b] Samples collected during intensive operating period (IOPs); five 2-hour samples per day.

[c] Two 2-hour samples per day.

Table 2-2. Permanent air quality research stations operated during the 1996 Paso del Norte Ozone Study. (Table only shows sites where O_3, NO_x, and/or hydrocarbons were observed.)

Site	ID	Latitude (decimal degrees)	Longitude (decimal degrees)	Elevation (m msl)	AIRS #	O_3	NO	NO_x	CO	PM	Hydrocarbons	Surf Met
La Union, NM	NLU	31.9306	106.6306	1204	350130008	X						X
University Avenue, Las Cruces, NM	NLC	32.2814	106.7672	1188	350131012	X			X			X
Sunland Park City Yard, NM	NSP	31.7958	106.5575	1200	350130017	X				X	Aug 6, 8-10 [a,b]	X
Las Cruces Holman, NM	NHM	32.4247	106.6742	1189	350130019	X	X	X		X		X
Chaparral Elem., Chaparral, NM	NCH	32.0408	106.4092	1249	350130020	X	X	X		X		X
Desert View Elem., Sunland Park, NM	NDV	31.7961	106.5839	1209	350130021	X	X	X		X		X
Santa Teresa Intl. Border Crossing, NM	NST	31.7878	106.6828	1256	350130022	X			X	X		X
El Paso Dntn. CAMS 6 (Campbell)[a]	TED	31.7625	106.4869	1140	481410027	X	X	X	X		IOP [a]	X
El Paso East CAMS 30 (Ascarate Park)	TEE	31.7536	106.4042	1126	481410028	X			X		Aug 6-10 [a,b] & $^1/_6$	X
El Paso UTEP CAMS 12	TUT	31.7683	106.5006	1143	481410037	X	X	X	X		$^1/_6$	X
Chamizal Park	ECH	31.7681	106.4542	1128	481410044	X			X	X	Hourly	X
Tecno (Chihuahua State Technical Inst.)	MJT	31.7156	106.3942	1123	800060001	X			X	X		X
Advance Transformer	MJA	31.6900	106.4597	1167	800060004	X	X[a]	X[a]	X	X		X
20-30 Club	M23	31.7375	106.4673	1150	800060006	X	X[a]	X[a]			IOP [a]	X
Zenco	ZEN	31.6381	106.4431	1183	800060003					X	Aug 15-16 [a,b]	

O_3 - Ozone, NO - Nitric oxide, NO_x - The sum of nitric oxide and nitrogen dioxide, CO - Carbon monoxide, PM - Particulate matter, Surf Met - Surface meteorological variables, Hourly - Continuous hourly sampling (auto-GC), $^1/_6$ - Eight 3-hour samples collected every 6 days, IOP - Five 2-hour samples collected on IOP days.

a Temporary equipment installed at existing sites; all other equipment is permanent.

b Two 2-hour samples per day.

samples collected at 20-30 Club and CAMS 6. Prior to shipment to the field, DRI and Biospherics Research Corporation (BRC) certified the polished stainless-steel canisters as free of contamination. The laboratory analytical process is based on gas chromatography (GC) with a flame-ionization detector (FID) to quantify each hydrocarbon identified, plus CO and total non-methane hydrocarbons (TO-12). Individual compounds will be resolved with up to 10 carbon atoms, and will include those emitted by vegetation such as isoprene and alpha- and beta-pinene. Compound identification is confirmed intermittently via mass spectrometry. The hydrocarbon analysis process also includes blanks, duplicate analyses, duplicate samples collected at the same time, and some samples exchanged with EPA and other laboratories.

Surface Carbonyl Measurements

The use of carbon sampling cartridges is the most widely used methodology to measure carbonyls. However, conflicting evidence exists in literature and in discussions among technical experts, questioning specific aspects such as: (1) substrate, (2) absorption reagent, (3) substrate/reagent ratios, (4) potential ozone interference, (5) blank levels and variability, (6) possible biases due to ozone removal procedures, and (7) concentrations of carbonyl compounds with three or more carbon atoms (C_3+). Even though these issues have not been fully resolved, existing data suggest that the full range of carbonyl compounds may be important in the Southwest (Fung, 1994; Zielinska, 1996; Martin and Popp, 1996). Therefore, carbonyls through C7 were measured during the 1996 Paso del Norte Ozone Study. Carbonyl samples were collected using dinitrophenylhydrazine (DNPH)-impregnated C18 Sep-Pak cartridges without ozone scrubbers, coated by DRI. During IOPs, two-hour samples were collected five times per day at 0600-0800, 0800-1000, 1000-1200, and 1200-1400, and 1600-1800 MDT at two surface air quality sites (Turf Road and Winn Road) by AV. Similar two-hour samples were collected at the 20-30 Club during IOPs after September 5 by LANL. AV and LANL shipped the samples for analyses to DRI. All cartridges were stored refrigerated and shipped cool. DRI will analyze nearly all ~~approximately 50 percent~~ of the samples collected, with the exception of those collected on September 18. The laboratory analytical process includes high performance liquid chromatography (HPLC) to separate and identify the carbonyl compounds in an acetonitrile extract of each cartridge. The compounds include: formaldehyde, acetaldehyde, acetone, propanal, methyl ethyl ketone, butanal, pentanal, and C5, C6, and C7 carbonyls.

To better understand uncertainties, a large number (about 10 to 20 percent) of field blanks were collected at all sites. Some of these blanks were exposed as a second cartridge in series downstream of the primary cartridge in order to determine whether the scrubbing efficiency was close to unity. If so, this second cartridge serves as a dynamic field blank. If not, true scrubbing efficiencies can be evaluated and accounted for.

2.1.3 Upper-Air and Surface Meteorological Measurements

Table 2-3 lists the project's radar profiler/RASS (radio acoustic sounding system), surface meteorological sites, sodars, and their positions (latitude and longitude). The locations of these sites are shown in **Figure 2-2**. John Archuleta of Los Alamos National Laboratory (LANL) and Lin Lindsey of Sonoma Technology, Inc. (STI) were responsible for operation of the three radar profilers. TNRCC operated two sodars (contact: Ed Michel).

Table 2-3. Upper-air and surface meteorological measurement sites used during the 1996 Paso del Norte Ozone Study.

Site	ID	Equipment	Latitude (Decimal degrees)	Longitude (Decimal degrees)
Bustamante Wastewater Plant	ELE	RP/RASS[a,b] surface met	31.65	-106.32
Delta-Haskel Wastewater Plant	ELD	RP/RASS[a,c] sodar[d] surface met	31.76	-106.43
Texas D.o.T.	ELW	RP/RASS[a,b] surface met	31.89	-106.6
Sun Metro	SUN	sodar[d]	31.759	-106.501
Lower Valley Water Well 414	LVW	sodar	31.70	-106.35
La Union, NM	NLU	surface met	31.9306	-106.6306
University Avenue, Las Cruces, NM	NLC	surface met	32.2814	-106.7672
Sunland Park City Yard, NM	NSP	surface met	31.7958	-106.5575
Las Cruces Holman, NM	NHM	surface met	32.4247	-106.6742
Chaparral Elem., Chaparral, NM	NCH	surface met	32.0408	-106.4092
Desert View Elem., Sunland Park, NM	NDV	surface met	31.7961	-106.5839
Santa Teresa Intl. Border Crossing, NM	NST	surface met	31.7878	-106.6828
El Paso Tillman, TX	TIL	surface met	31.7569	-106.4828
El Paso Downtown CAMS 6 (Campbell), TX	TED	surface met	31.7625	-106.4869
El Paso East CAMS 30 (Ascarate Park), TX	TEE	surface met	31.7536	-106.4042
Ivanhoe Fire Station	IVH	surface met	31.7881	-106.3217
El Paso UTEP CAMS 12	TUT	surface met	31.7683	-106.5006
Chamizal Park	ECH	surface met	31.7681	-106.4542
Lindbergh Elementary School	LIN	surface met	31.8606	-106.5864
Tecno (Chihuahua State Technical Institute)	MJT	surface met	31.7156	-106.3942
Advance Transformer	MJA	surface met	31.6900	-106.4597
20-30 Club	M23	surface met	31.7375	-106.4673

[a] Radar profiler (RP) with RASS systems measure upper-air wind speed, wind direction, and virtual temperature. Radar sites also have surface meteorological measurements of wind speed, wind direction, temperature, pressure, relative humidity, total solar radiation, and precipitation.

[b] Operated by STI.

[c] Operated by LANL.

[d] Sodar was moved from Sun Metro to Delta-Haskel on September 8.

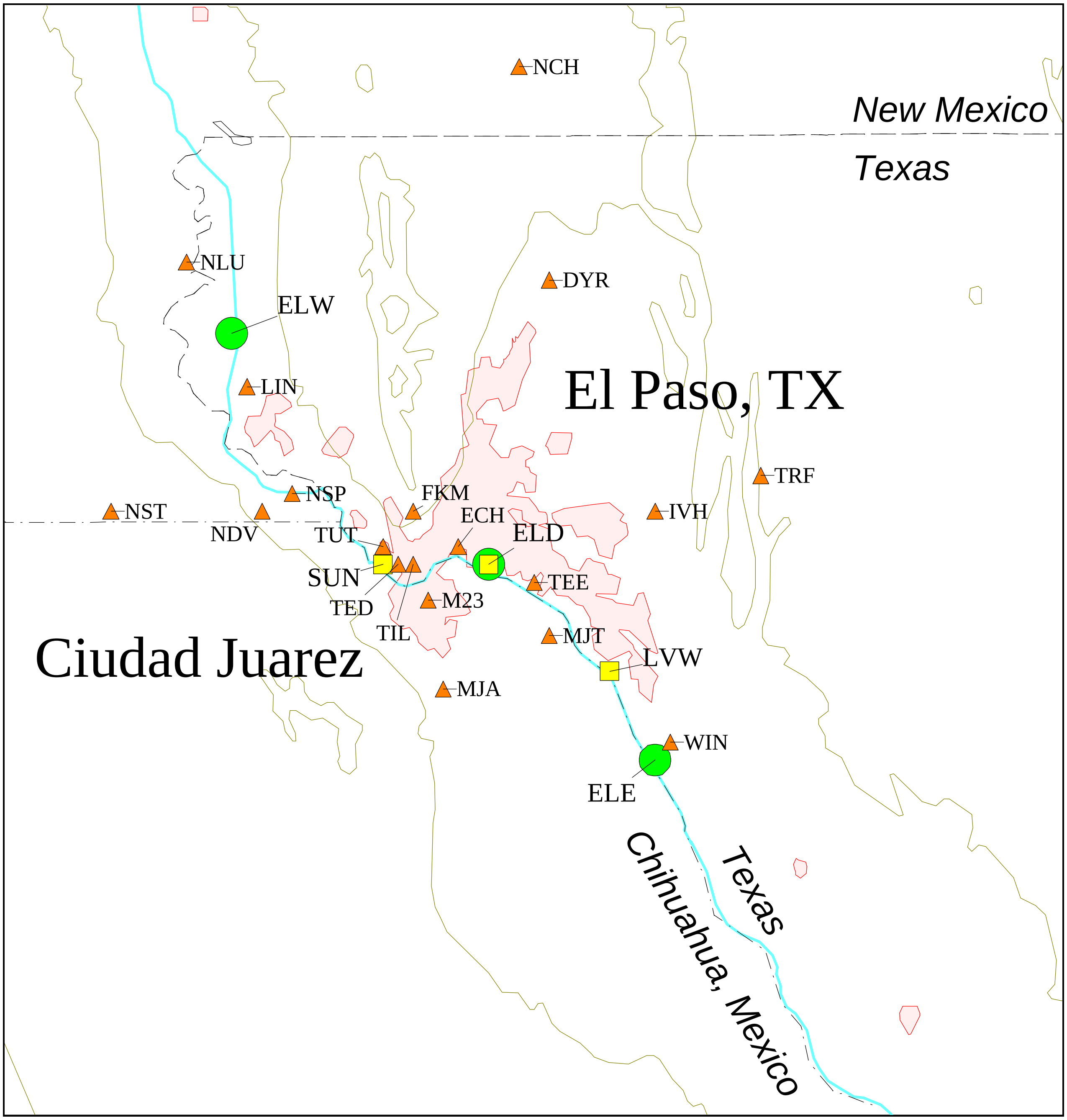

Figure 2-2. Locations of radar profilers with RASS and surface met (circles), surface met stations (triangles), and sodars (squares).

Note: Surface meteorological stations were colocated at the ELW, ELD, and ELE sites.

Table 2-4. Details of the aircraft flight pattern.

Spiral No.	Spiral 3-Letter ID	Ground Elevation (meters msl)	Description
Initial flight at Spiral 1	ELP	1206	Surface up to 2740 m HCs and Cnyls 1360 to 1664 m
Subsequent flights at Spiral 1	ELP	1206	3050 m down to a low pass HCs and Cnyls 3050 m to 2740 m
2	CJS	1171	2740 m down to a low pass HCs and Cnyls 1630 to 1322 m
3	STI	1255	2740 m down to a low pass
4	TW1	1248	Low pass up to 2740 m HCs and Cnyls 1300 to 1600 m
5	RAT	1224	2740 m down to a low pass
6	NWN	1326	Low pass up to 2740 m
7	TW2	1230	2740 m down to a low pass HCs and Cnyls 1690 to 1380 m
8	FBN	1121	2740 m down to a low pass
9	BWP	1116	Low pass up to 3050 m HCs and Cnyls 1270 m to 1570 m

downtown Juarez followed by a spatial survey of ozone concentrations over a large downwind area. Weather permitting, afternoon flights were also conducted (in varying locations on August 13, 14, and September 21), followed by additional downwind spatial ozone surveys. Tethered balloon launch sites included (1) the baseball stadium at the intersection of Americas Avenue and Guerrero (near the 20-30 Club) site, (2) near the Advanced Transformer (MJA) air quality monitoring site, and (3) the University Sports Stadium near the United States border. Further details will be available in the Tethersonde Final Report.

Fuel Samples

In addition, liquid gasoline and diesel fuel samples were collected at stations in El Paso and Juarez, including all grades and a range of brands. The samples will be analyzed for Reid Vapor Pressure (RVP) by the El Paso City-County Health Department, and for hydrocarbon speciation by Bob Seila at EPA.

2.1.4 Summary Schedule of Field Measurements

Table 2-5 summarizes the dates on which various field activities occurred. Note that this is preliminary and may contain errors. Note that the IOP period was originally planned

2.2 COORDINATION AMONG PASO DEL NORTE OZONE STUDY ORGANIZATIONS AND INDIVIDUALS

Each measurement contractor maintained regular communications with the Observations Coordinator or operations center. **Table 2-6** lists the telephone and fax numbers of several individuals involved in the field study. Instrument problems were reported as soon as possible; reports provided as much information as possible, including information on the location of the problem, the type of problem, and the parameter(s) affected, the proposed solutions to the problem, and the expected length of time the equipment was expected to be inoperative. Additional responsibilities of key individuals during the field measurements are listed below. If any of the field measurement personnel had problems, they contacted the Observations Coordinator at the earliest possible time.

Observations Coordination: Paul Roberts, assisted by Dana Coe, STI, set up an operations center in Santa Rosa, CA for maintaining contact with the study participants. The Observations Coordinator monitored the progress of the study and the readiness of the participants, and provided oversight and assistance to the participants to solve problems. Paul Roberts coordinated the daily decision-making process, made the daily decision on IOP sampling and made available required information and sampling decisions to the study investigators.

Surface air quality and meteorology: Jerry Thelan and David Pankratz, AV, managed the surface air quality and meteorology observations, kept the Observations Coordinator informed of the operational status of their air quality and meteorological equipment, supervised the collection of hydrocarbon and carbonyl samples for later laboratory analysis during IOPs, and provided equipment status and previous day's maximum ozone concentrations by 1230 MDT daily. Jose-Luis Arriaga, IMP, Bob Seila, EPA, and Clay Heskitt, LANL, were responsible for the supplemental hydrocarbon sampling and for hydrocarbon and carbonyl sampling at the 20-30 Club and Advance Transformer. Barbara Zielinska, DRI, provided hydrocarbon cans, carbonyl cartridges, and sampling systems and supervised the collection of heavy hydrocarbon samples. AV, El Paso City-County Health and Environmental Department, TNRCC, and the New Mexico Environment Department provided the previous day's maximum 1-hour average ozone concentrations to the Observations Coordinator by 1230 MDT. DRI, USEPA, and the University of Texas at Austin provided hydrocarbon and/or carbonyl analytical services.

Upper-air and surface meteorology: John Archuleta, LANL, and C.G. (Lin) Lindsey, STI, managed the operation of the radar profiler/RASS systems, provided operational status of the radar profiler/RASS equipment and surface meteorological equipment to the Observations Coordinator by 1230 MDT daily, and provided upper-air wind and temperature data to the Observations Coordinator as needed.

Aircraft: Jerry Anderson, STI, managed the aircraft operations. He provided operational status of the aircraft and equipment by 1300 MDT daily; and supervised the preparation of the aircraft for field sampling and the aircraft sampling flights.

Table 2-6. Individuals involved with the 1996 Paso del Norte Ozone Study.

Name	Organization	Telephone	Fax
Jim Yarborough, Bob Seila	USEPA (Dallas office) USEPA (Research Triangle Park office)	(214)665-7232 (919)541-2214	(214)665-7263 (919)547-4787
Mark Saeger	Science Applications International Corp.	(919)544-3856	(919)544-4175
Paul Roberts, C.G. (Lin) Lindsay, Jerry Anderson, Bastian Schoell	Sonoma Technology, Inc.	(707) 527-9372	(707)527-9398
Jerry Thelan, David Pankratz	AeroVironment	(818)357-9983	(818)357-0989
Ed Michel, Brian Lambeth, Victor Valenzuela	Texas Natural Resources Conservation Commission	(512)239-1384 (915)778-9634	(512)239-0696 (915)778-4576
Jesus Reynoso, Henry Del Rio	El Paso City-County Health and Environmental District	(915)771-5800	(915)771-5714
Clay Heskitt John Archuleta	Los Alamos National Labs	(505)667-4418 (505)522-9333	(505)246-6001 (505)521-9619
Steve Watson, Russ Price	University of Utah	(801)771-2016	(801)777-6179
Chuck Bruce, Al Jelinek	New Mexico State University	(505)522-9330	(505)646-1934
Erik Aaboe, Josephine Ball	New Mexico Environment Department	(505)827-0031	(505)827-0045
Barbara Zielinska, Dick Egami, Dale Crow, John Bowen	Desert Research Institute	(702)677-3198	(702)677-3157
Jose-Luis Arriaga	Instituto del Petroléo Mexicano	011-5216-16-7625	
David Allen	University of Texas at Austin	512-471-0049	

Hot Air Balloon: Steve Watson and Russ Price, University of Utah, prepared the hot-air balloon for operation. Steve Watson piloted the balloon while Russ Price led the chase/recovery crew. Bastian Schoell, STI, prepared and operated the balloon sampling equipment during flight.

Tethersonde: Chuck Bruce, NMSU, planned and managed the tethersonde measurements in Juarez.

Meteorological Forecasting: Brian Lambeth, TNRCC, and Tim Dye and Scott Ray, STI, provided daily meteorological and air quality forecasts for the study region by 1300 MDT; provided both current and forecast products; and provided other relevant information (e.g., satellite images, trajectory forecasts, severe weather probabilities). Some of these products were faxed to the Observations Coordinator each day, while other information was obtained by the Observations Coordinator or his staff during daily conference calls. Details about the forecasting methodology are addressed in the Section 3.

Current and forecasted air quality conditions. The current and forecasted air quality depended heavily on the current and forecasted meteorological conditions. The goal was to identify periods when ozone concentrations would be 125 ppb or higher.

Review of the frequency of occurrence of ozone episodes and of data regarding previous forecasts versus actual ozone concentrations suggested that sampling should be performed even if forecasted ozone values were below 125 ppb. In 1996 the sampling budget was predicated on up to 10 IOP sampling days. This expenditure goal was not expected to be exceeded when calling IOPs on widespread forecasts of around 100 ppb ozone or higher.

During days prior to an IOP, the forecasted meteorological conditions were the primary method for determining the potential for high ozone on the following day. The current day's ozone concentrations may or may not show evidence of a build-up in ozone concentrations. When an IOP was performed, the decision to continue the IOP was based heavily on the current air quality conditions as well as the forecasted meteorological and air quality conditions.

Additional issues which were considered include the following:

Operational readiness of equipment: In general, it was desirable for all equipment to be operational during an IOP. However, forecasted episodes were not ignored nor IOPs canceled even if a critical piece of equipment was inoperable. Note that many routine measurements were performed on all days, even if an IOP was not called. A schedule of the intensive measurements which were made on IOP days is provided in **Table 3-1**.

Table 3-1. Approximate times of intensive sampling activities during the 1996 Paso del Norte Ozone Study.

Time (MDT)	Activity
0530-0830	Morning aircraft flight; Early-morning Juarez tethersonde flight followed by spatial survey
0600-0800	Early-morning surface hydrocarbon/carbonyl sampling
0700-0900	Hot-air balloon flight (if performed)
0800-1000	Morning surface hydrocarbon/carbonyl sampling
1000-1200	Mid-morning surface hydrocarbon/carbonyl sampling
1100-1400	Mid-day aircraft flight
1200-1400	Afternoon surface hydrocarbon/carbonyl sampling
1200-1700	Afternoon downwind tethersonde survey (if performed) followed by spatial survey
1600-1800	Evening surface hydrocarbon/carbonyl sampling
2100-2330	Night aircraft flight (if performed)

Table 4-1. Air quality sites in the El Paso-Ciudad Juarez-Sunland Park area with ozone concentrations greater than or equal to 100 ppb during the August 13, 1996 episode. Data shown are unreviewed, Level 0. They are incomplete and may contain errors.

Site Name	State	Ozone Max. (Level 0 Data) (ppb)
La Union	NM	101
Santa Teresa	NM	105
Desert View	NM	117
Sunland Park	NM	112
El Paso UTEP CAMS 12	TX	126
El Paso Downtown CAMS 6	TX	134
El Paso Chamizal Park	TX	137
20-30 Club	MX	129
Franklin Mountain	TX	115*

* Incomplete data at Franklin Mountain. Maximum ozone concentration may be higher.

August 17, 1996

There were no exceedences of the ozone NAAQS on August 17; however, the third highest daily ozone maximum concentration observed during the IOP forecasting period occurred on this date. The maximum 1-hour average ozone concentration was 105 ppb at the Desert View, NM site. The measured ozone concentration reached 100 ppb or higher at only one other site: El Paso CAMS 12 where the concentration reached 103 ppb.

2.3 SUMMARY OF INTENSIVE MEASUREMENTS

Continuous air quality and meteorological measurements were conducted at the surface air quality and meteorological, radar profiler, and sodar sites throughout the El Paso-Ciudad Juarez-Sunland Park area from late July through mid-September, as discussed in earlier sections. Additional measurements were made at the surface and aloft on IOP days and some additional days (see Table 2-5).

Tables 4-2 **through 4-4** ~~**and 4-3**~~ summarize the intensive aircraft, surface, and hot-air balloon hydrocarbon and carbonyl measurements made as part of the summer ozone study. Table 4-2 lists the number of aircraft flights performed, the number of hydrocarbon and carbonyl samples collected on each flight, and the route flown. Table 4-3 lists the number of hydrocarbon and carbonyl samples collected at each surface air quality research station.

Table 4-2. Number of hydrocarbon and carbonyl samples collected during each aircraft flight of the 1996 Paso del Norte Ozone Study.

Date	Flight	No. HC Samples Collected	No. Carbonyl Samples Collected
8/11/96	Night	0	0
8/12/96	Morning IOP	5	5
8/12/96	Afternoon IOP	5	5
8/12/96	Night	0	0
8/13/96	Morning IOP	5	5
8/13/96	Afternoon IOP	5	5
9/2/96	Supplemental	3	3
9/4/96	Supplemental	4 ~~3~~	4 ~~3~~
9/5/96	Morning IOP	5	5
9/5/96	Afternoon IOP	5	5
9/6/96	Supplemental	4 ~~3~~	4 ~~3~~
9/7/96	Supplemental	3	3
9/9/96	Supplemental	3	3
9/10/96	Supplemental	3	3
9/13/96	Afternoon IOP	5	5
9/16/96	Supplemental	3	3
9/17/96	Supplemental	3	3
9/18/96	Supplemental	3	3
9/20/96	Supplemental	3	3
9/21/96	Morning IOP	5	5
9/21/96	Afternoon IOP	5	5
	Totals	77 ~~75~~	77 ~~75~~

~~* Number of samples not yet confirmed for these dates.~~

Table 4-3. Number of surface hydrocarbon and carbonyl samples collected during the 1996 Paso del Norte Ozone Study.

Date	No. of HC/Carbonyl Samples Collected			
	El Paso CAMS 6 (TED)	20-30 Club (M23)	Turf Road (TRF)	Winn Road (WIN)
8/11/96	5/0	0 ~~5~~/0	3 ~~5~~/5 ~~6~~	3 ~~5~~/5
8/12/96	5/0	5/0	6 ~~5~~/5	4 ~~5~~/5
8/13/96	5/0	5/0	6 ~~5~~/5	6 ~~5~~/5
8/14/96	5/0	5/0	6 ~~5~~/5	6 ~~5~~/4 ~~5~~
9/5/96	5/0	6 ~~5~~/5 ~~0~~	5/5	5/5
9/13/96	5/0	5/5 ~~0~~	5/5	5/5
9/16/96	5/0	5/5 ~~0~~	5/5	5/5
9/17/96	5/0	5/5 ~~0~~	5/5	5/5
9/18/96	5/0	5/5 ~~0~~	5/5	5/5
9/21/96	5/0	5/5 ~~0~~	5/5	5/5
Totals	50/0	45 ~~50~~/30 ~~0~~	51 ~~50~~/51	48 ~~50~~/49 ~~50~~

~~* Number of samples not yet confirmed for these dates.~~

Table 4-4. Number of hydrocarbon and carbonyl samples collected during each hot-air balloon flight of the 1996 Paso del Norte Ozone Study.

Date	No. HC Samples Collected	No. Carbonyl Samples Collected
9/9/96	3	0
9/13/96	3	4
9/17/96	4	4
	10	8

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